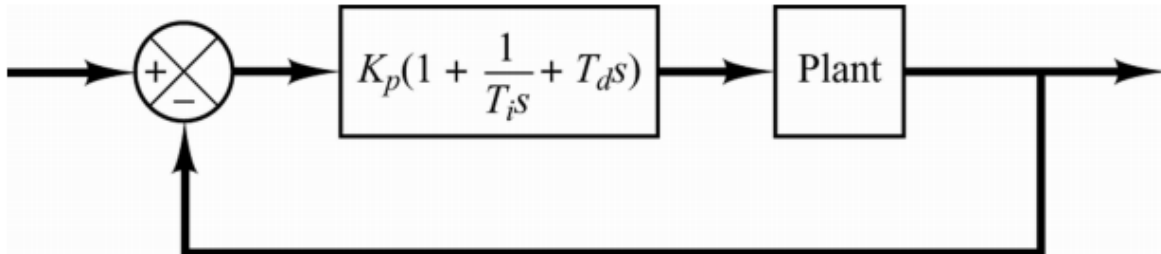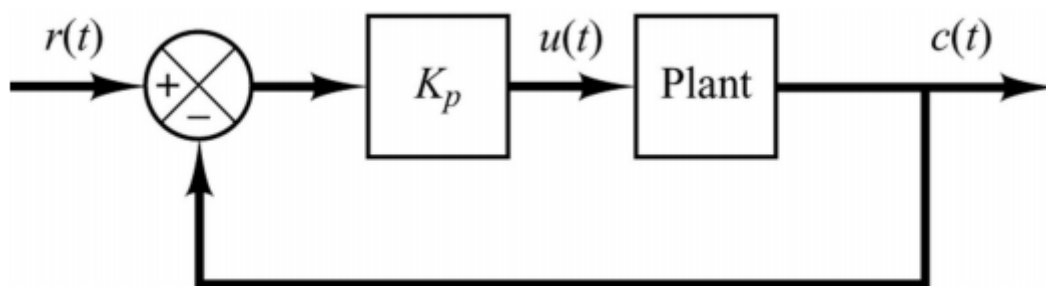# Ziegler-Nichols Tuning, Second Method

- PID Controller;
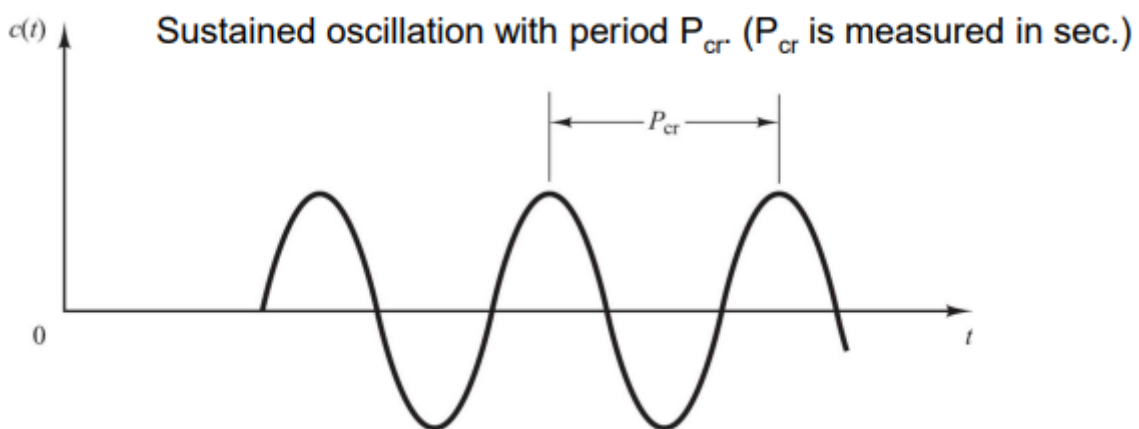

$$\frac{U(s)}{E(s)} = G_{PID}(s) = K_P + K_I \frac{1}{s} + K_D s = K_P \left(1 + \frac{1}{T_I s} + T_D s \right)$$

- Start with proportional controller.
- This method may cause unstability or damage, so be carefull when applying.

- Start with a small value of K_p
- Increase K_p until the output of the loop oscillates

Sustained oscillation with period P_{cr}. (P_{cr} is measured in sec.)

- Use estimation table below;

Type of Controller	K_p	T_i	T_d
P	$0.5K_{cr}$	∞	0
PI	$0.45K_{cr}$	$\dfrac{1}{1.2}P_{cr}$	0
PID	$0.6K_{cr}$	$0.5P_{cr}$	$0.125P_{cr}$